

# **Play and Learn: Potentials of Game-Based Learning**

**by**

**Maja Pivec**



# *Play and Learn: Potentials of Game-Based Learning*

Presented by

**Dr Maja Pivec**

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FH JOANNEUM  
Information Design

# *Game-Based Learning*

- Games and learning - how does this work?
- Game about designing a game & results
- Transferability - GBL in Medicine
- Games for Treatment

# *Games Characteristics*

## **Game elements**

- Fantasy – Imaginary or fantasy context, themes, or characters.
- Rules/Goals – Clear rules, goals, and feedback on progress towards the goals.
- Sensory Stimuli – Dramatic or novel visual and auditory stimuli.
- Challenge – Optimal level of activity and uncertain goal attainment.
- Mystery – Optimal level of informational complexity.
- Control – Active learner control.

Malone, T. W. (1981). What makes computer games fun? *Byte*, 6(12), 258-277.

## *Games - Motivation and Learning*

Games enhance motivation and  
increase students interest in subject matter

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*... yet the extent to which this translates into  
more effective learning is less clear*

[Druckman (1995)]

## *Games - Theory of “Flow”*

- Tasks that can be completed.
- The ability to concentrate on the task.
- Where concentration is possible because the task has clearly identified goals.
- Where concentration is possible because the task provides immediate feedback.
- The ability to exercise a sense of control over one's actions.
- An immersion that removes awareness of the frustrations of everyday life.
- The concern for ones self disappears but emerges stronger afterwards.
- The sense of the duration of time is altered.

[60]

[Csikszentmihalyi, M. (1990)]

## *Games - Immersion*

*Causes a  
“persistant re-engagement”  
of the Player.*

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Kearney, P., & Pivec, M. (2007). *Immersed and how? That is the question.*  
Paper presented at the Games in Action Conference, Gothenburg, Sweden.

# *Games - Identifying Immersion*

Eye Tracking to Identify Player Immersion



III

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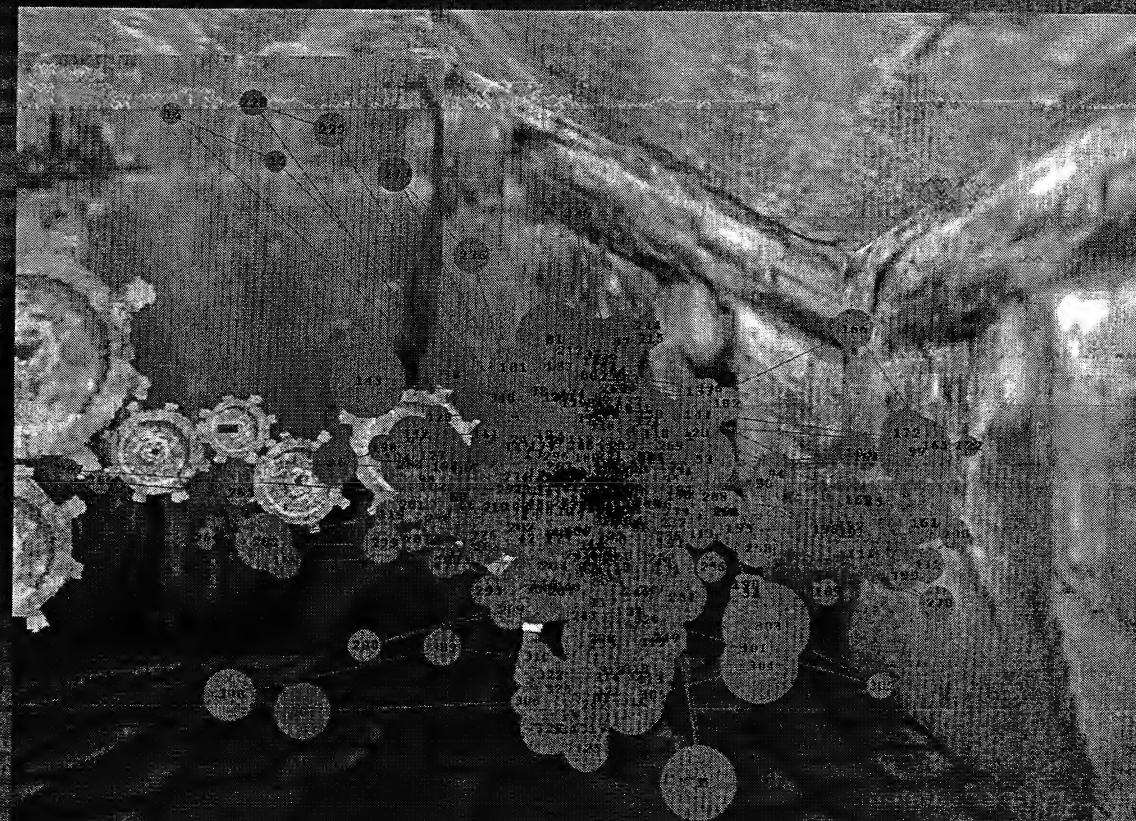
# *Games - Eye Tracking*

*Quake II*



# *Games - Eye Tracking*

*Tomb  
Raider*



STUDY: sims2. STIMULUS: game. RECORDING: tombraider. FRAME: StaticBitmap.bmp.  
TIME SEGMENT: Only include fixations inside interval [0,197819] ms.

Tracking by Tobii

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# *Games - Eye Tracking*

*NeverWinter  
Nights*



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# *How to design effective learning opportunities?*

- learners are encouraged to combine knowledge from different areas to choose a solution or to make a decision at a certain point,
- learners can test how the outcome of the game changes based on their decisions and actions,
- learners are encouraged to contact other team members and discuss and negotiate subsequent steps,
- thus improving their social skills.

## *Game-Based Learning*

*Learning is the acquisition of knowledge or skills through experience, practice, or study.*

*Learning outcomes are the knowledge, skills, and abilities that the student will possess following the learning experience.*

# *Player's Learning Outcomes*

- Skill-based learning outcomes  
*performance of technical or motor skills*
- Cognitive learning outcomes  
*declarative knowledge*  
*procedural knowledge*  
*strategic knowledge*
- Affective learning outcomes  
*beliefs or attitudes regarding an object or activity*

## *In-Game Cycle*

Concrete Experience

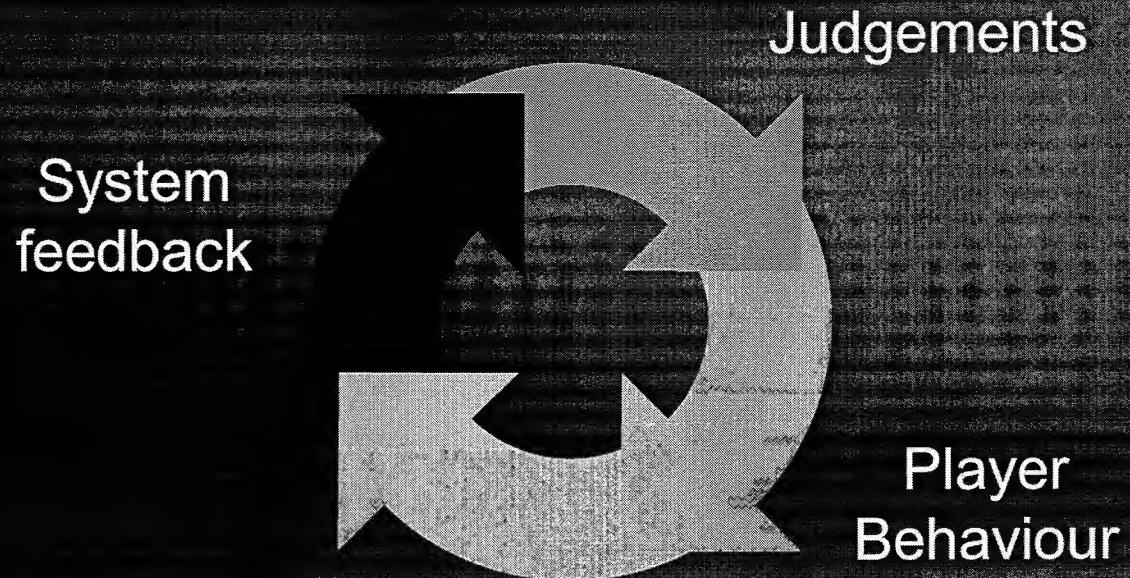
Active  
Experimentation

Reflective  
Observation

Abstract Conceptualisation

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice-Hall.

## *In-Game Cycle*



Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming*, 33(4), 441-467

## *Player's Reflection*

- Reflection-in-Action

*If play is broken up with reflection, learning is reduced. If reflection is dispersed within the game, learning is increased.*

## *Player's Abilities*

- The Player must be able to enter the game at the appropriate level
- The cognitive challenge must be appropriate for the player's ability
- As the player's skill level is incremented, the challenge must increase

## *Player's Abilities*

*“Persistent Re-engagement comes from  
Player Immersion”*

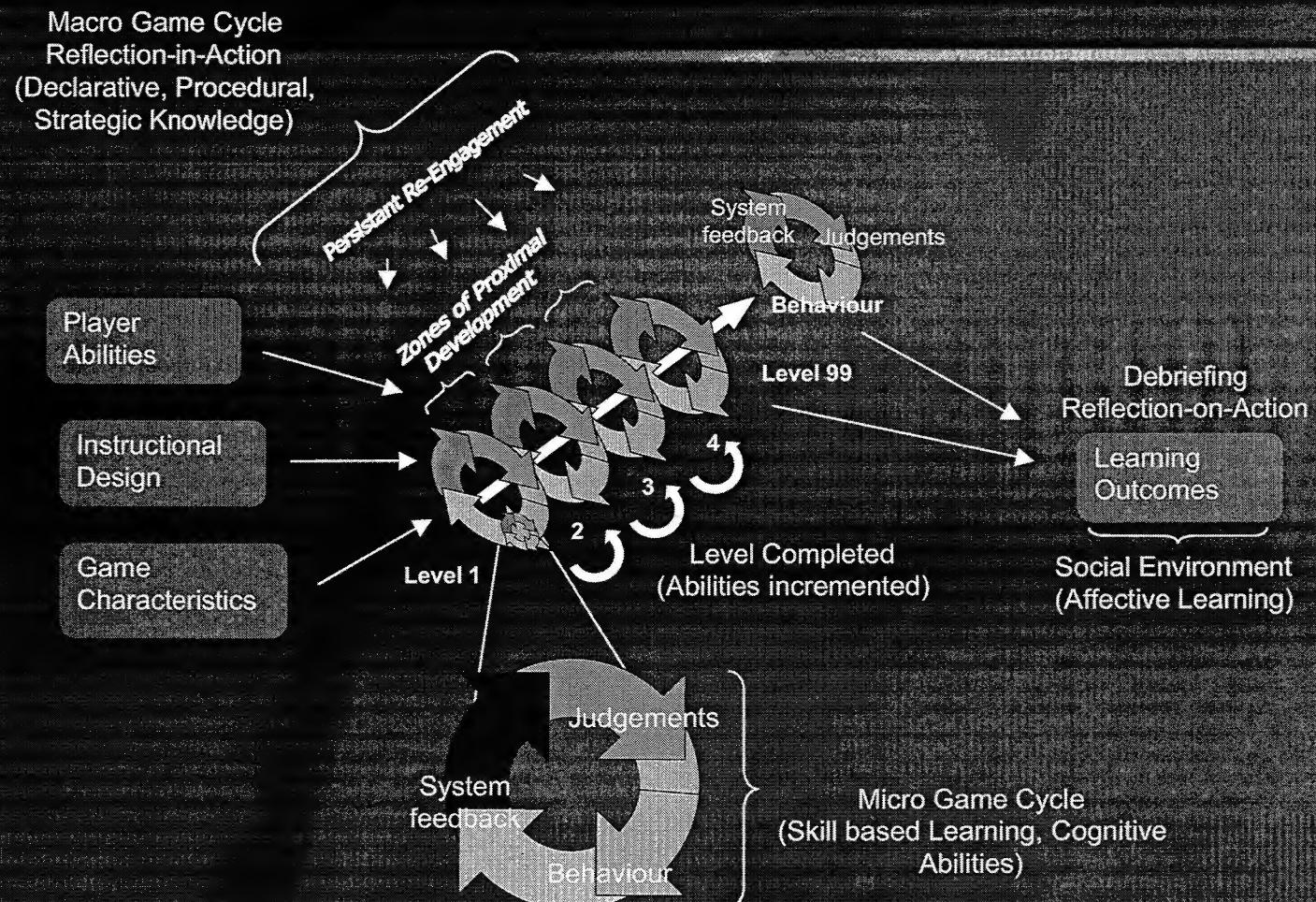
122

*“Player Immersion is the result of  
Scaffolded Challenge”*

*So how does this occur....*

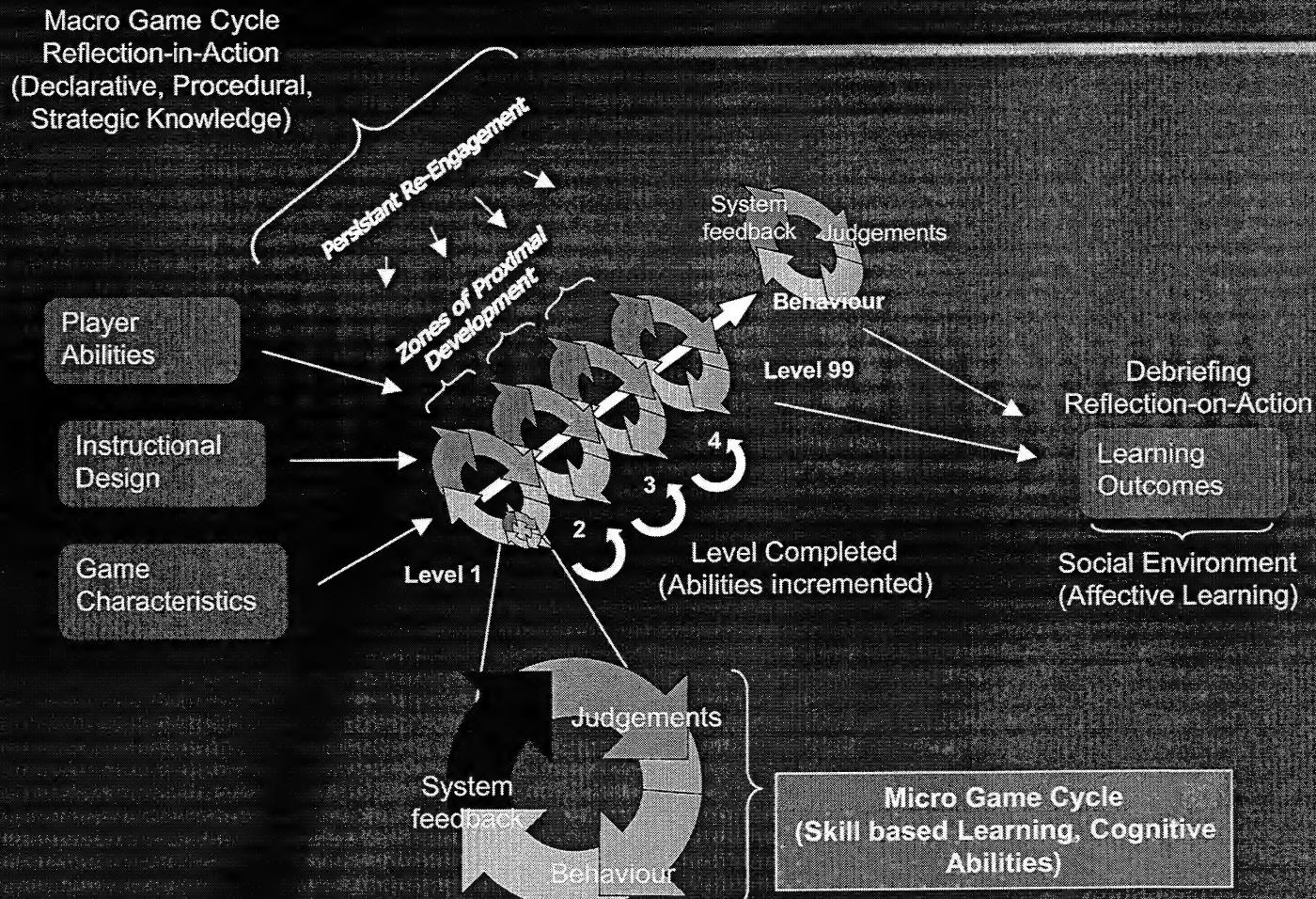
Kearney, P., & Pivec, M. (2007). *Immersed and how? That is the question.*  
Paper presented at the Games in Action Conference, Gothenburg, Sweden.

# Model of Game-Based Learning



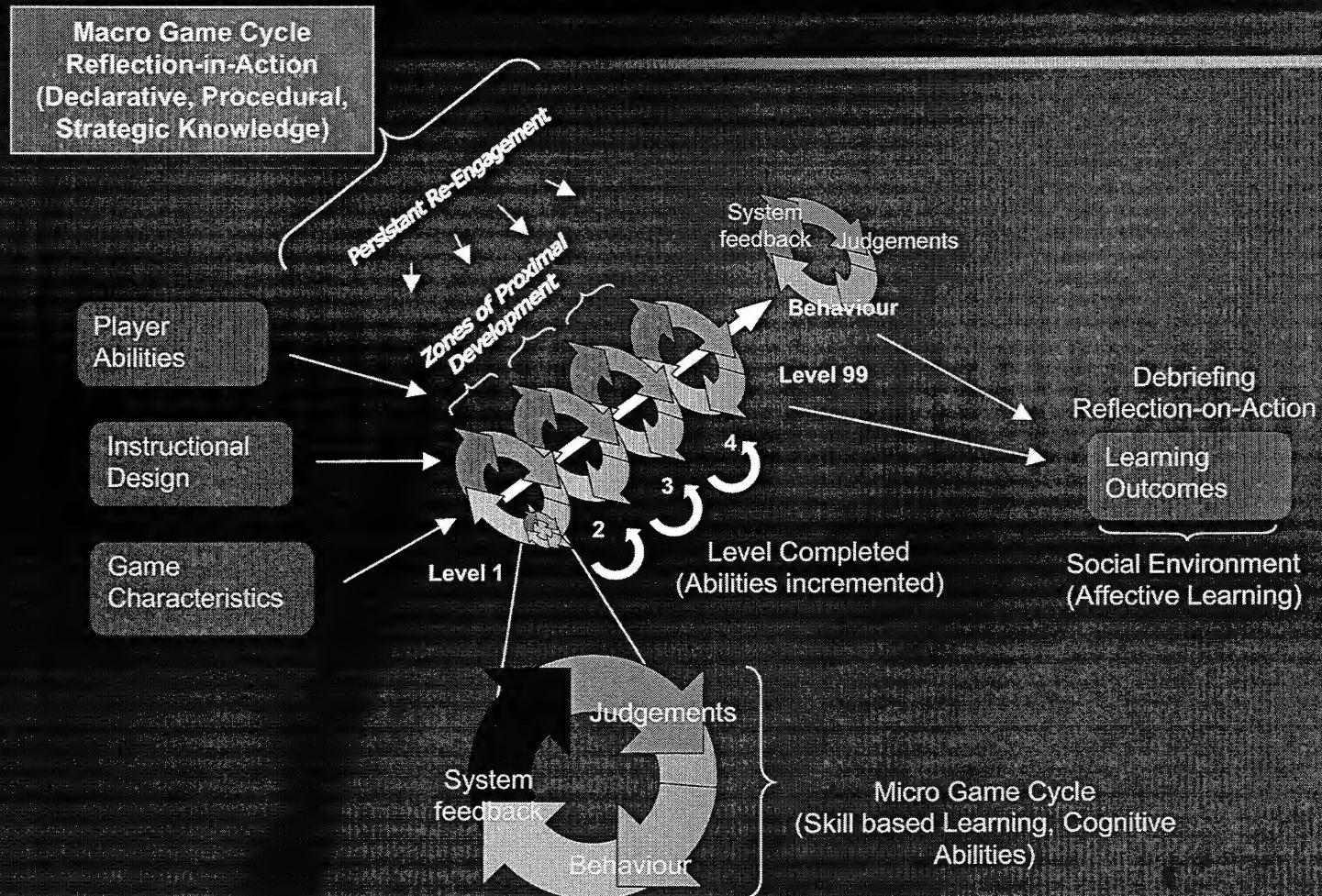
# Model of Game-Based Learning

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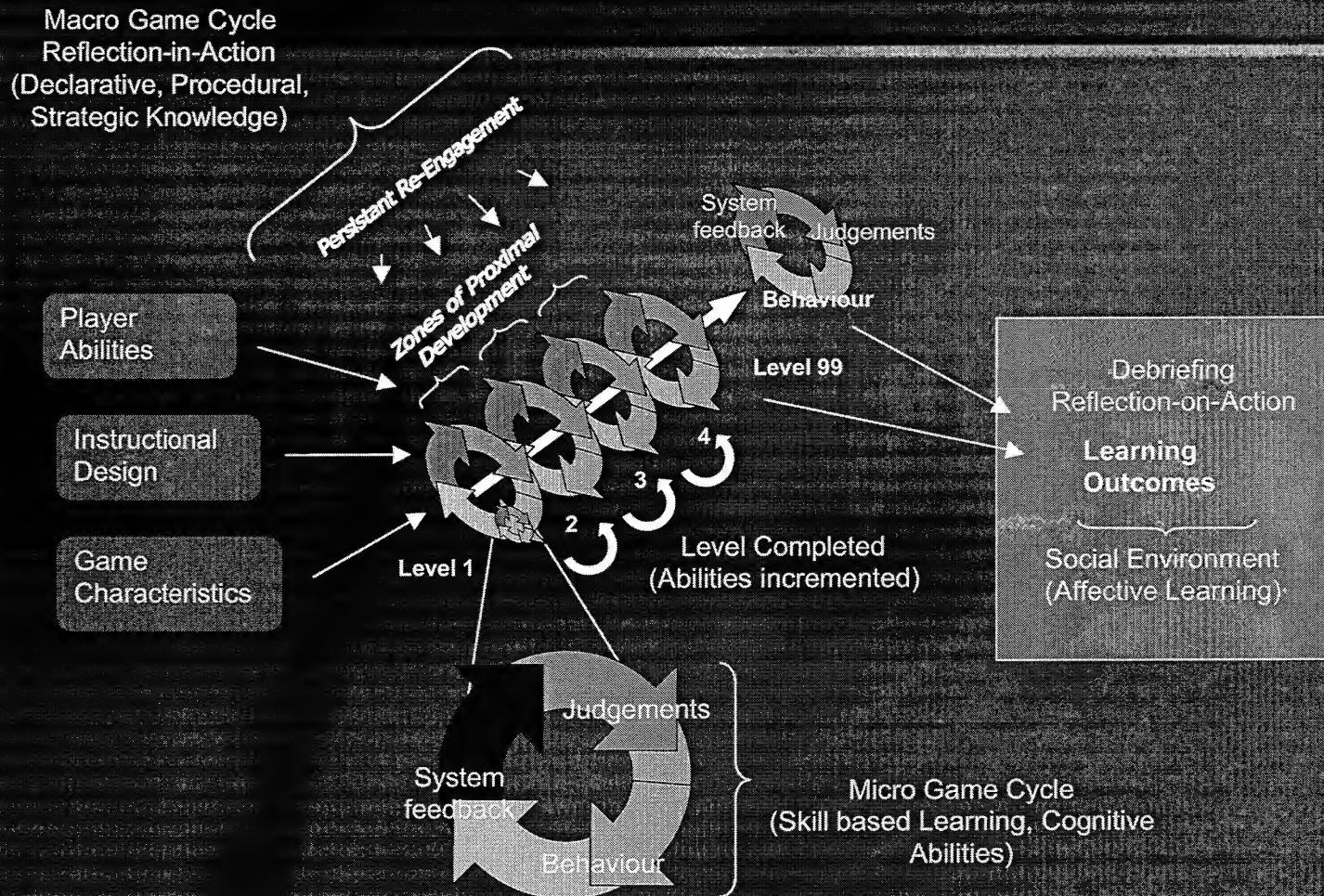


# Model of Game-Based Learning

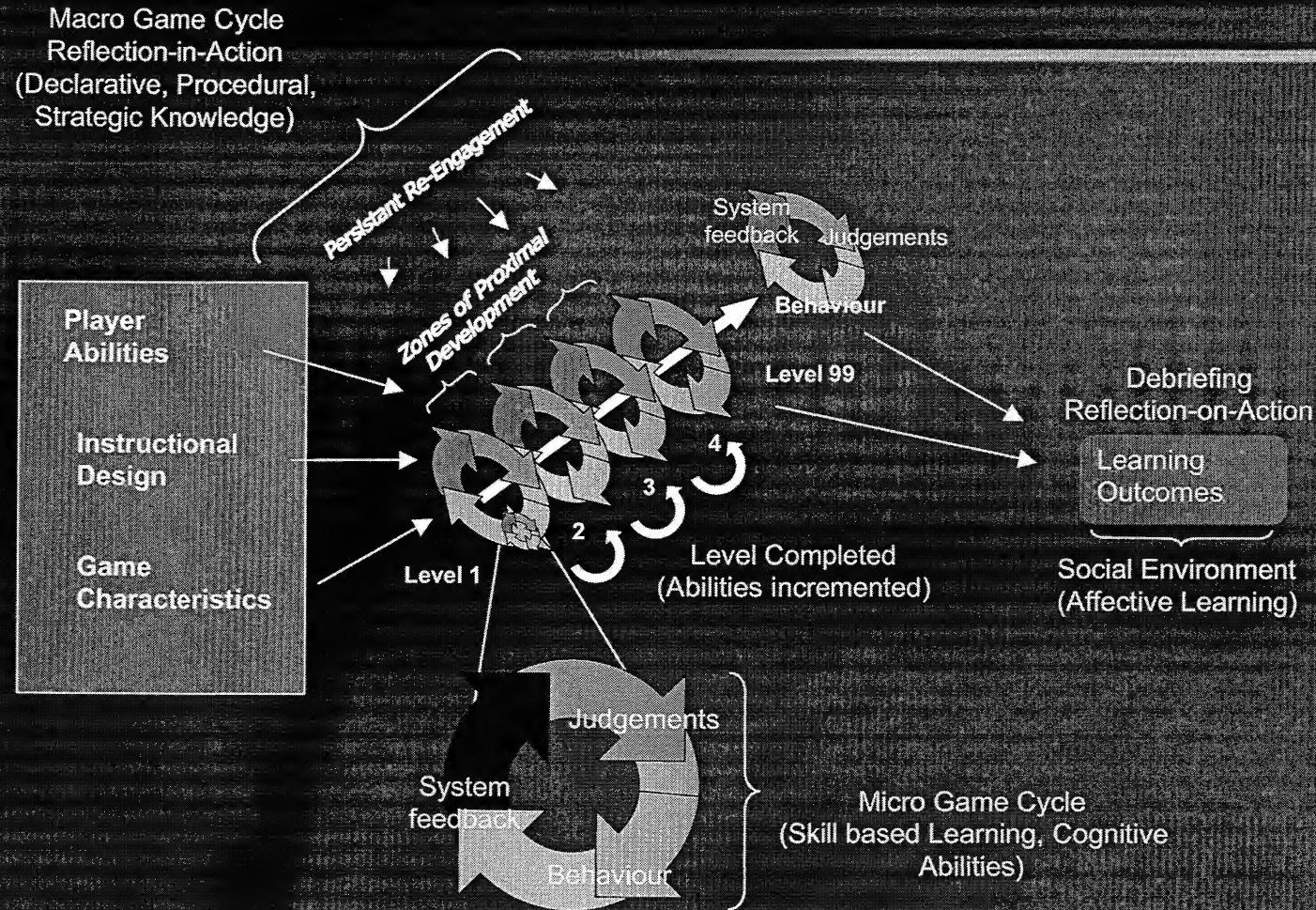
125



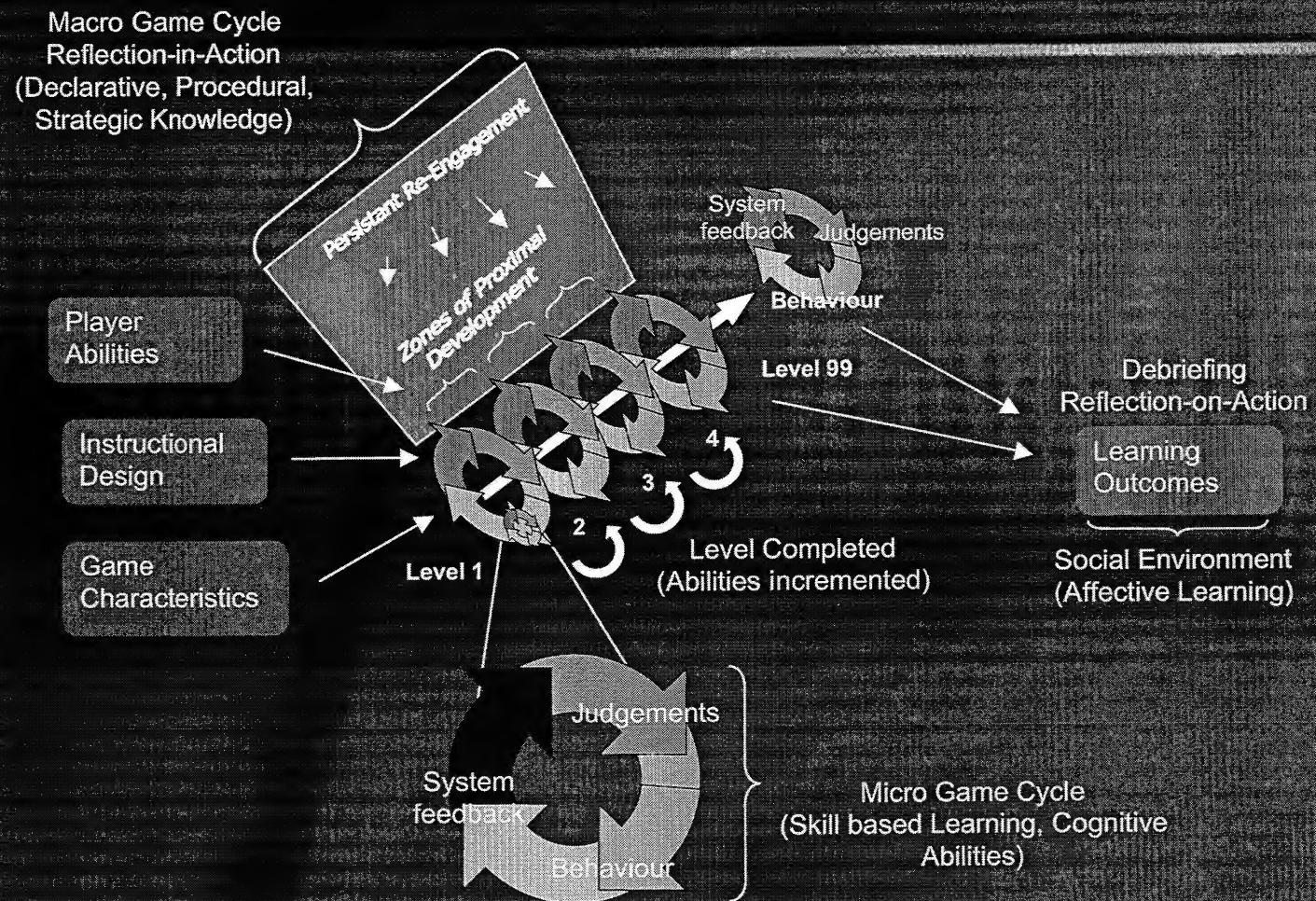
# Model of Game-Based Learning



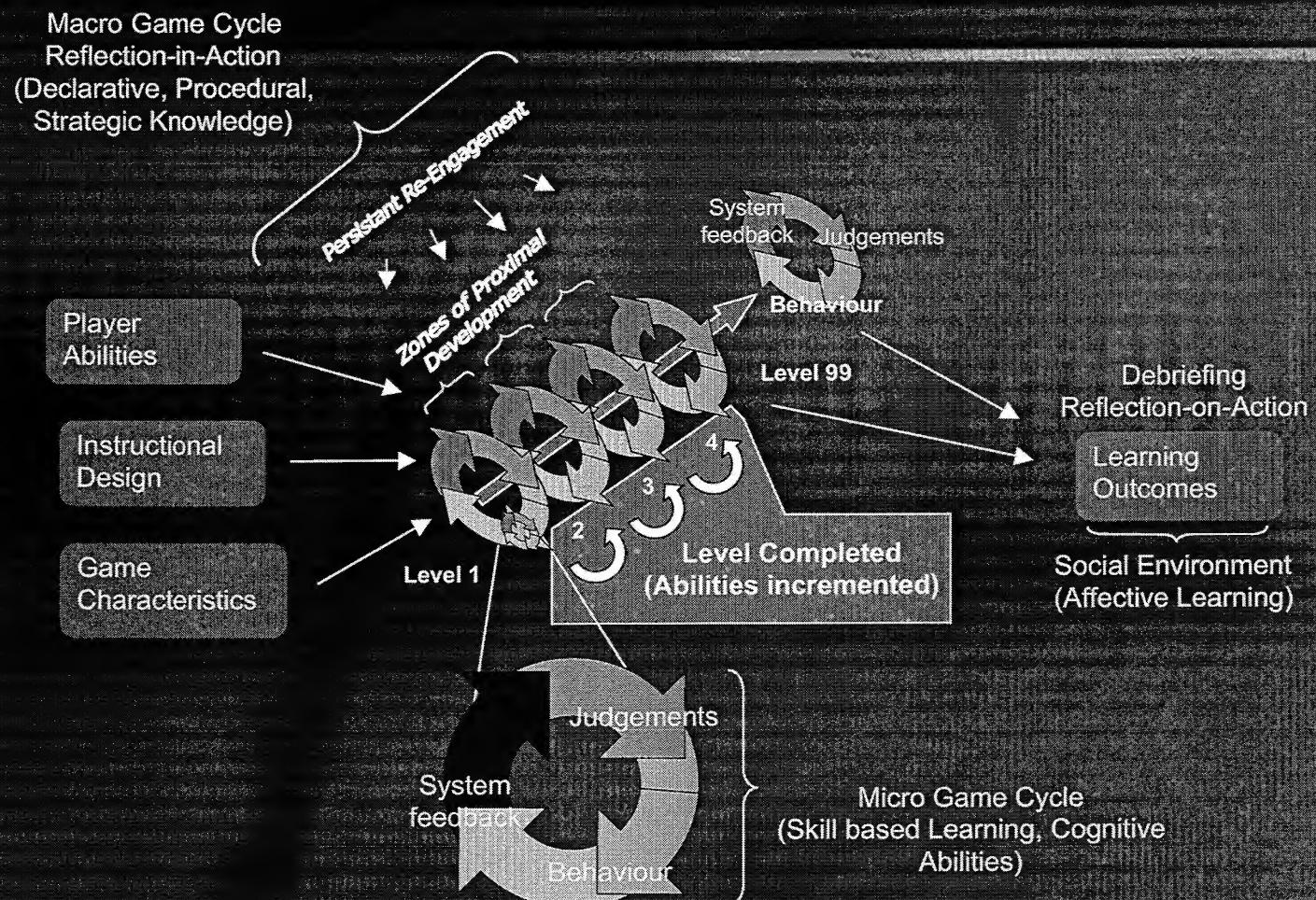
# Model of Game-Based Learning



# Model of Game-Based Learning



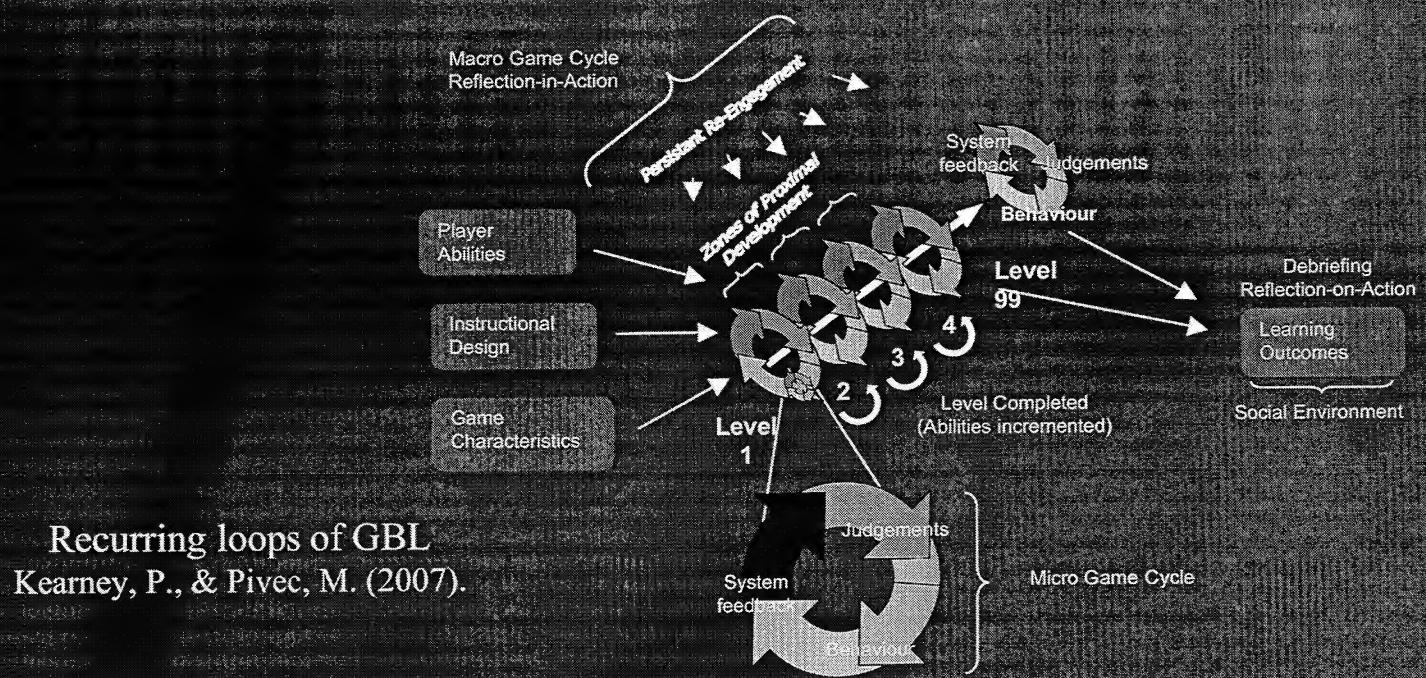
# Model of Game-Based Learning



# Model of Game-Based Learning

*Game-Based Learning occurs in a recursive loop  
and as such, as skills are acquired or incremented,  
the player moves to the next level of the game.*

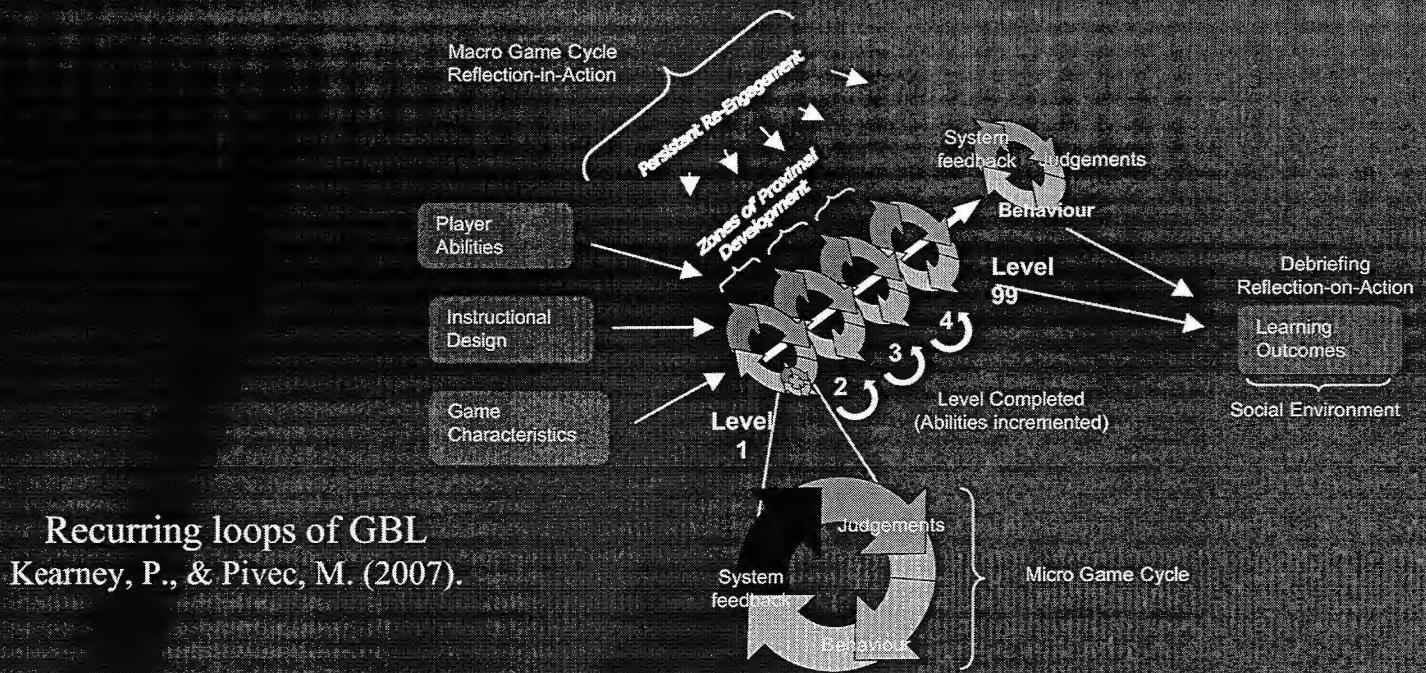
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# *GBL - Learning Outcomes*

*Game-Based Learning is the “vehicle” that fosters the acquisition of learning outcomes.*

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Recurring loops of GBL

Kearney, P., & Pivec, M. (2007).

# *GBL - Learning Outcomes*

- Learning Objective: *Memory/ Repetition/ Retention*
- Definition: *Factual Knowledge*
- Appropriate Games/ Typology:

*Drill and Practice*  
*Quiz games*  
*Puzzle games*

# *GBL - Learning Outcomes*

- Appropriate Games/ Typology:

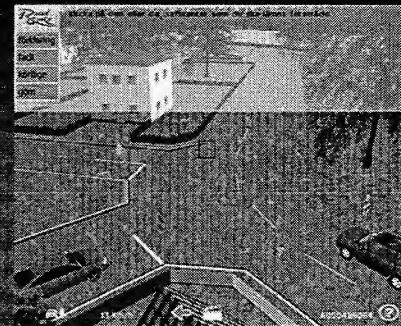
*Drill and Practice*

*Quiz games*

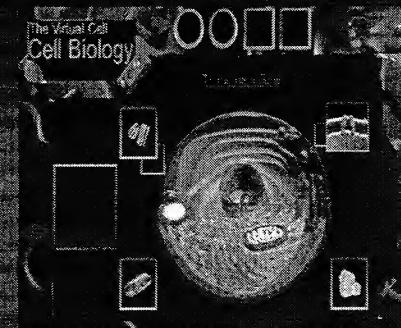
*Puzzle games*

- Examples:

Roadquiz



Virtual Cell



## *GBL - Learning Outcomes*

- Learning Objective: *Dexterity/ Spread, Precision/ Motoric*
- Definition: *Sensorial/ dexterous knowledge*
- Appropriate Games/ Typology:

*Combat/ fighting games*

*Driving games*

*Simulation games*

# *GBL - Learning Outcomes*

- Appropriate Games/ Typology:

*Combat/ fighting games*

*Driving games*

*Simulation games*

- Examples:

Doom



Flight Simulator



# *GBL - Learning Outcomes*

- Learning Objective: *Applying Concepts/ Rules*
- Definition: *Translate knowledge into new context: use information, use methods, concepts, theories in new situations*
- Appropriate Games/ Typology:
  - Sport games*
  - Action games*
  - Driving games, Drill & Practice*

# *GBL - Learning Outcomes*

- Appropriate Games/ Typology:

*Sport games*

*Action games*

*Driving games, Drill & Practice*

- Examples:

FIFA



Driver



# *GBL - Learning Outcomes*

- Learning Objective: *Decision-making (strategy & problem solving)*
- Definition: *Analysis of knowledge based on problem solving, prediction, drawing conclusions, choice making, reasoned argument*
- Appropriate Games/ Typology:
  - Strategic games*
  - Adventure games*
  - Role Play games*
  - Simulation games*

# *GBL - Learning Outcomes*

- Appropriate Games/ Typology:

*Strategic games*

*Adventure games*

*Role Play games*

*Simulation games*

- Examples:

SimCity



Monkey island



# *GBL - Learning Outcomes*

- Learning Objective: *Ability to learn/ Self-assessment*

- Definition: *Evaluation*

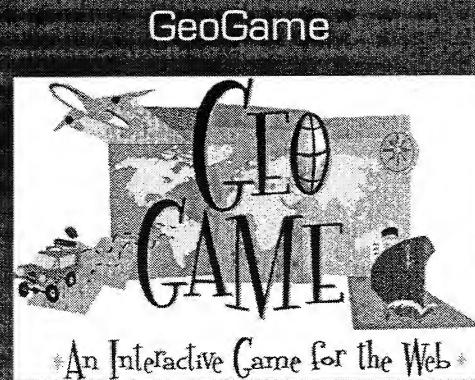
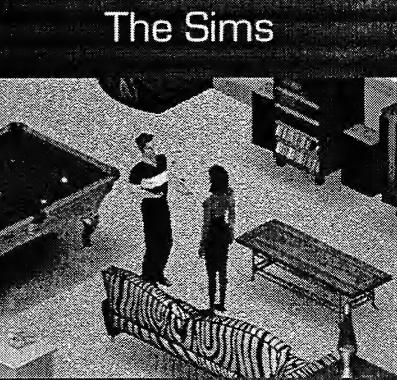
- Appropriate Games/ Typology:

*Role play games*

*Simulation games*

# *GBL - Learning Outcomes*

- Appropriate Games/ Typology:
  - Role play games*
  - Simulation games*
- Examples:



# *Educational game design*

- Constructivist learning theory
- Exploratory approach to learning
  - interaction, coping with problems, understanding of the whole
  - learners are active participants in knowledge acquisition
  - learners are engaged in restructuring, manipulating, re-inventing, and experimenting with knowledge

# *Educational game design*

## Pedagogical goals:

1. to provide an experience with the knowledge-construction process,
2. to provide experiences encouraging appreciation of multiple perspectives,
3. to embed learning in realistic and relevant contexts,
4. to encourage ownership in the learning process,

# *Educational game design*

## Pedagogical goals:

5. to embed learning in social experience,
6. to encourage the use of multiple modes of representation,
7. and to encourage self-awareness of the knowledge construction process

*Game about designing a Game*

- Team work — one team, one company
  - role within a team – role in a company
  - game producer, game developer, programmer
- Goal – concept of an educational game

## *Golden Pineapple Award*

*"Anaphylactic" from Dudary Entertainment*

*"Keep Me Alive" from Stardust Enterprises*



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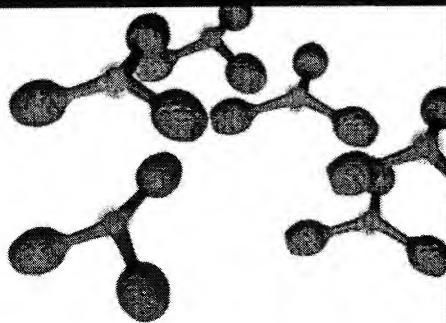
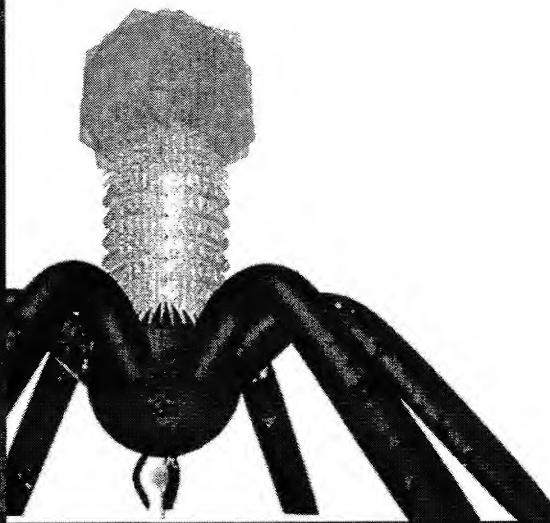
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*Anaphylactic*



# *Anaphylactic*

.the game

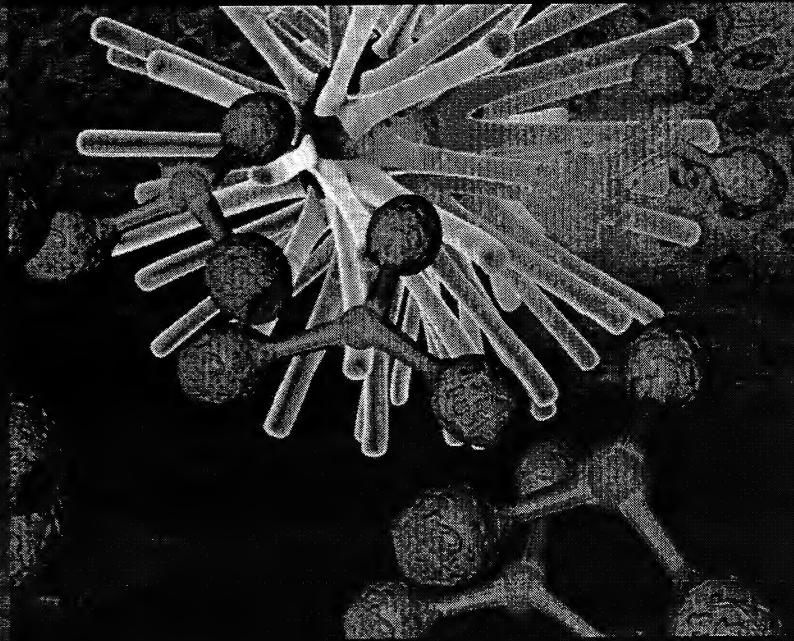


DUDARY  
entertainment

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# *Anaphylactic*



.the challenge

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# *Anaphylactic*

.the progress



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# *Anaphylactic*

.the interface



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# Anaphylactic

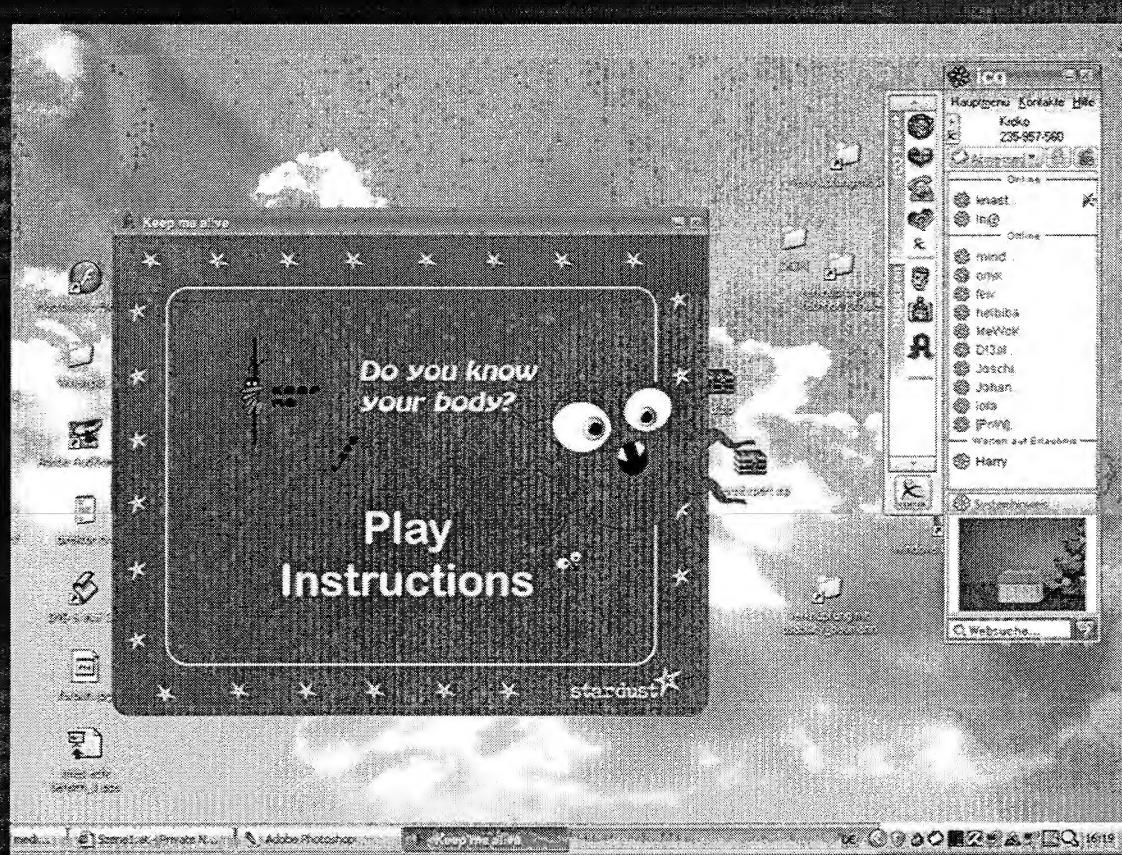
.the marketing



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# Keep Me Alive



# Keep Me Alive

Keep me alive

Do you know your body?

Skeleton  
Organs  
Charakter  
How to heal  
The Illness-battle

info

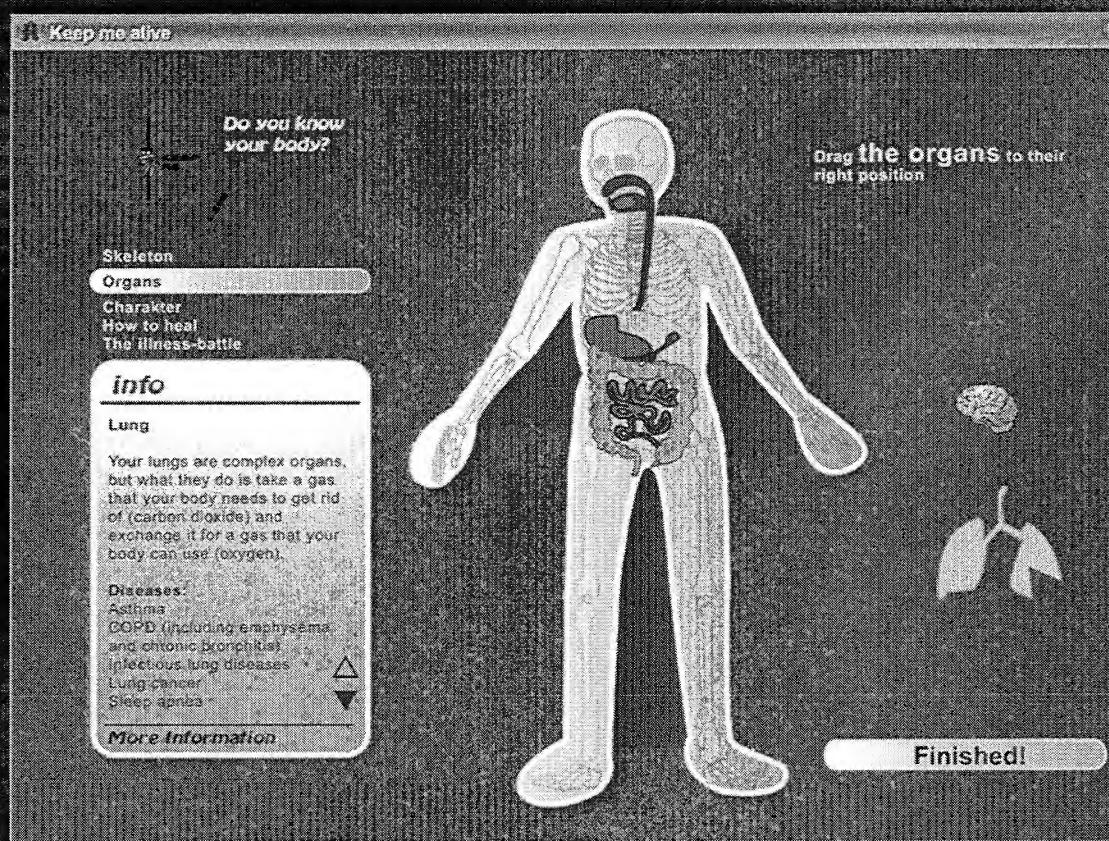
Cranium  
22 to 30 bones connected with seams  
Exercise:  
protect brain, eyes and tongue

More Information

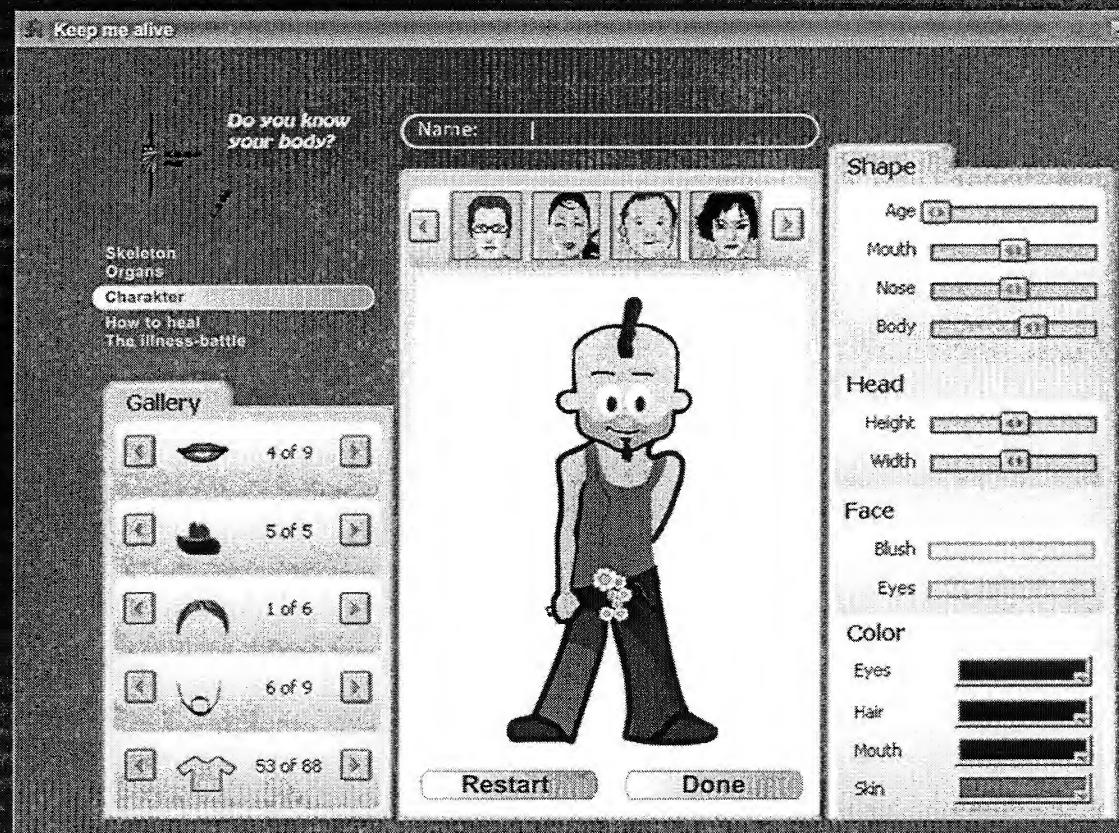
Drag the bones to their right position

Finished!

# Keep Me Alive

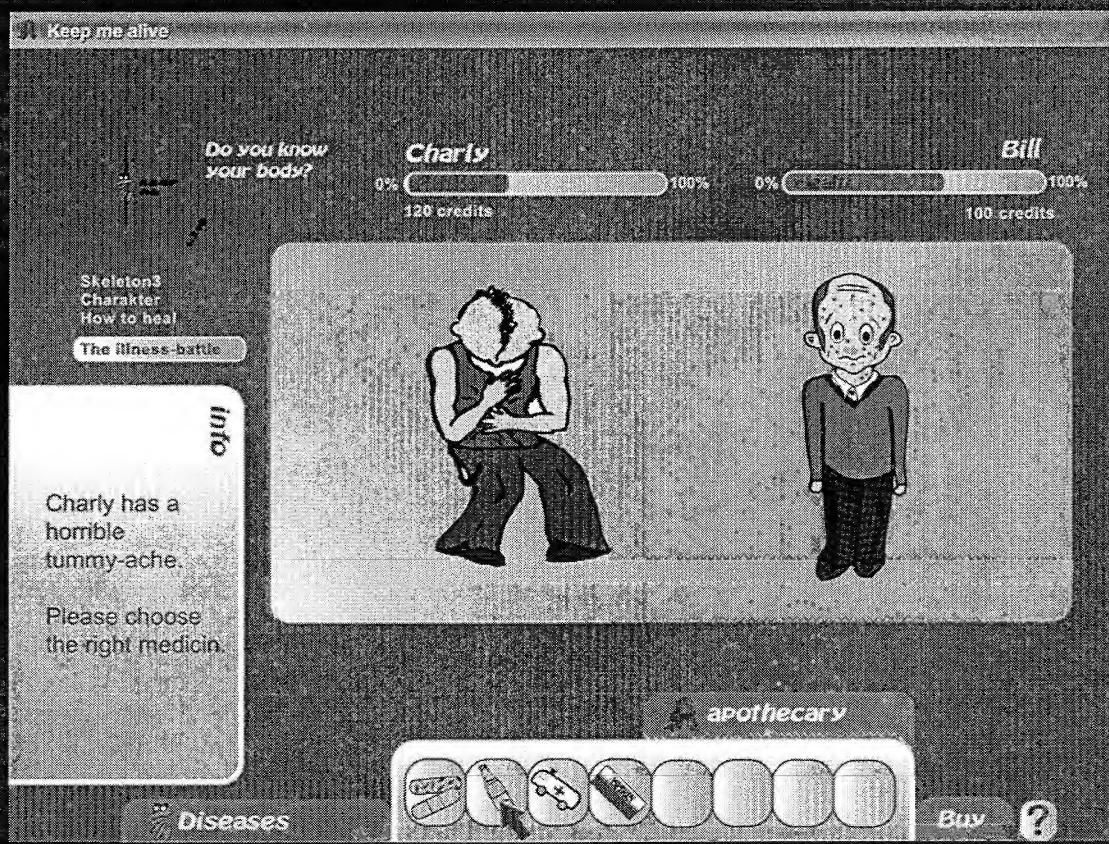


# Keep Me Alive





# Keep Me Alive



## *Potentials of GBL*

- Formal and informal learning
- Educational game for interdisciplinary learning
- Context based environment
- Off the shelf game

# *Contagion*

- role-playing adventure game
- fostering interdisciplinary learning
- targeted at children aged 10 – 15
- based on active exploration



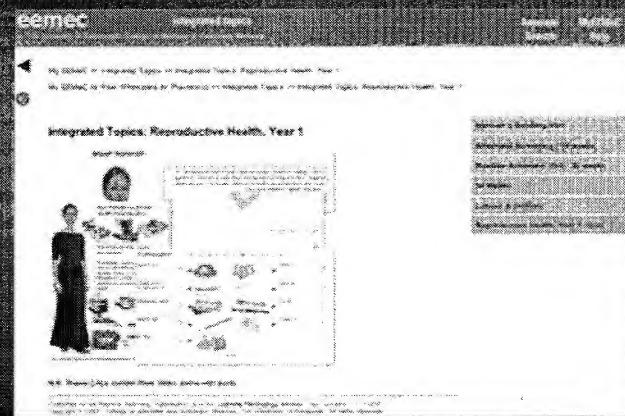
*[de Castell, 2006]*

*Information about deseases, such as Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Avian Flu, and Acquired Immune Deficiency Syndrome (AIDS)*

*Career preparation environment, community health officer, physician, or a medical researcher*

# George ... a virtual patient

- curricular topics blurred with narrative elements thus creating a realistic context
- condition gets more complicated as they progress in their studies



<http://www.eemec.med.ed.ac.uk/visitors/>

*Students are role playing "to be a doctor",  
until the end of their education when they become doctors*

[Begg et al 2006]

# Labyrinth

- situation (plus) various choices
- repeated interaction with “what if” reflections
- College of Medicine and Veterinary Medicine’s Learning Technology Section at the University of Edinburgh

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**Effect of weight on FRC:**

(Click on text in numbered order to view each section)

1. Elastic properties of the lungs      2. Elastic properties of the chest wall

3. Interaction of elastic properties of the lungs and chest wall

The gas left in the lungs at the end of a normal breath out is called the Functional Residual Capacity (FRC). The actual size of the FRC is dependent on the balance between the elastic recoil forces of the lungs and the chest wall.

<http://www.eemec.med.ed.ac.uk/visitors/>

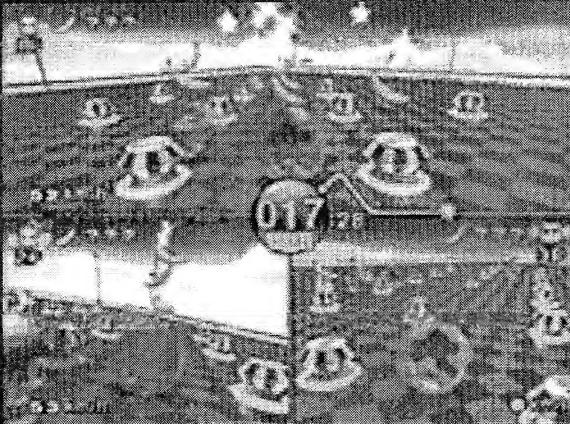
*Role-play focused on decision-making scenarios*

*[Begg et al 2006]*

# Top Gun

Video games as teaching tool for improvement of laparoscopic skills

- fewer errors,
- better performance
- faster completion



Super Monkey Ball - Nintendo © 1997-2007

*"Video games may help thin the technical interface between surgeons and screen-mediated applications"*

[Rosser et al 2007]

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# *Application Cases*

## e-Inclusion by means of Game-Based Learning

[Pivec *et al.*, 2005]

- Socialization
- Creating experience
- Therapeutic application of game environments

## *Socialization*

- personal development and improvement of self esteem of the learner
- establishing the dialogue and breaking social and cultural boundaries



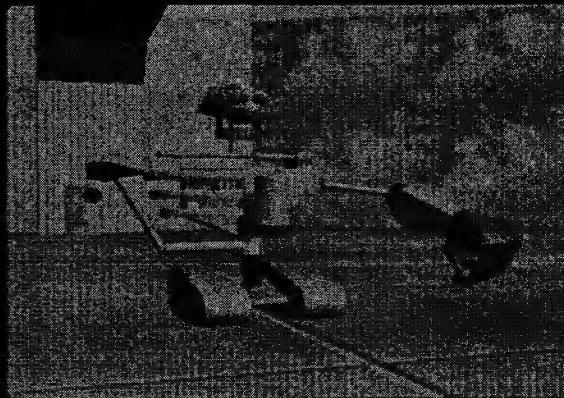
*„makes me feel like a  
real person“*

[Kearney, 2005]

# *Creating experience*

Terraformers - 3D adventure game for sighted and blind.

- provides a standard graphics mode
- also has a high contrast mode for gamers with low vision
- can be played with no graphics for the blind



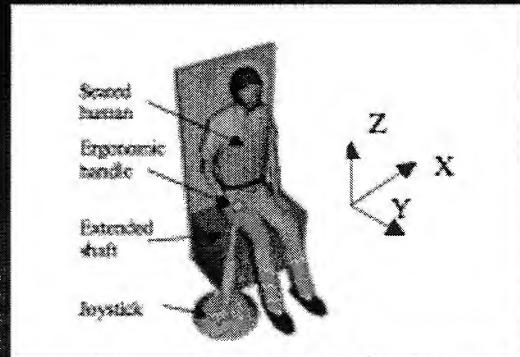
<http://www.terraformers.nu/eng/features.php>

## *Therapeutic application of game environments*

- force feedback joystick for the therapy of cerebral palsy
- 40% in movement precision and movement speed using this technique

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[Geerdink *et al.*, 2003]



## *Therapeutic application of game environments*

- VR and Sony's Eye-toy
- Snowboarding, Volleyball, Soccer.

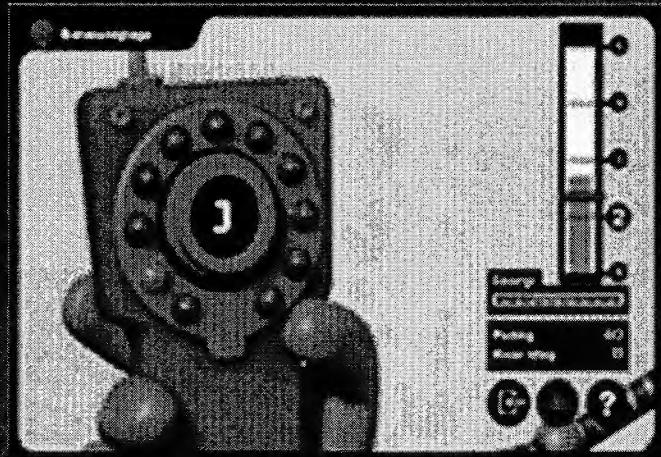


*"perceived physical changes and increased social acceptance from peers and family"*

[Miller & Reid, 2003]

# *Therapeutic application of game environments*

- RoboMemo
- improvement of working memory capacity



complementary treatment for people  
with Attention Deficit Hyperactivity  
Disorder (ADHD)

<http://www.cogmed.com/cogmed/articles/en/2.aspx>

## *Therapeutic application of game environments*

- PI - 3D game for adolescent psychotherapy
  - depression, anxiety and social skills problems, and engage more easily with therapists
- play therapy, therapeutic storytelling, interactive narrative systems

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Media Lab Europe and  
Trinity College Dublin  
[Coyle *et al.*, 2005]

# Conclusions

*The success of any game is dependant  
on the games ability to maintain immersion  
by staying within the upper zone  
of the player's ability.*

# Conclusions

*Opportunity to get the experiences and to learn in a  
“safe virtual world”*

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# Thank You

## Contact Details

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## Discussion

*Why don't we use games more often in classrooms?*

- Low tolerance of the environment for the games
- Perceived as unserious activity
- Fear not to reach learning objectives
- Lack of technical resources
- Quality of games as learning resources

## **II. Learning Theory Session**

### **How Learning Theory Supports Using Modeling, Simulation, and Game-Based Learning to Teach Science, Technology, Engineering, and Mathematics**